CLAIMS

We claim:

1. A method for inspecting a specimen by detecting electrons that scatter from the specimen comprising:

scanning and directing an electron beam to irradiate a spot on the specimen, the electron beam causing the electrons to scatter from the irradiated spot on the specimen;

setting a high pass filter at a first voltage level;

detecting the scattered electrons with the high pass filter that is set at the first voltage level, the high pass filter detecting a first electron intensity level of the scattered electrons;

setting the high pass filter at a second voltage level;

detecting the scattered electrons with the high pass filter that is set at the second voltage level, the high pass filter detecting a second electron intensity level of the scattered electrons;

determining a differential electron intensity level, which is the difference between the first electron intensity level and the second electron intensity level, whereby the differential electron intensity level is the electron intensity level in an energy window between the first and second voltage level; and

repeating each of the setting, detecting and determining operations to obtain additional differential electron intensity levels for successively irradiated spots along the scanned specimen, whereby the plurality of determined differential electron intensity levels provide inspection information about the specimen.

2. A method as recited in claim 1 wherein the plurality of differential electron intensity levels are used to generate a scanning electron image of the specimen.

3. A method as recited in claim 1 wherein the first and second voltage levels are set to encompass an energy spectrum wherein the respective scattered electrons that are detected are secondary electrons.

4. A method as recited in claim 3 wherein the first and second voltage levels are further set to encompass an energy spectrum such that secondary electrons displaying high mean free paths are not collected and secondary electrons displaying relatively lower mean free paths are detected, whereby the resolution of the inspection information is increased.

5. A method as recited in claim 1 wherein the first and second voltage levels are set to encompass an energy spectrum such that scattered electrons displaying high mean free paths are not collected and scattered electrons displaying relatively lower mean free paths are detected, whereby the resolution of the inspection information is increased.

6. A method as recited in claim 1 wherein the specimen is a semiconductor wafer and the inspection information is used to measure a critical dimension on the semiconductor wafer.

7. A method for determining an interface between a first material and a second material on a specimen by detecting electrons that scatter from the specimen, the method comprising:

scanning and directing an electron beam to irradiate a spot on the specimen, the electron beam causing the electrons to scatter from the irradiated spot on the specimen;

setting a high pass filter at a first voltage level;

detecting the scattered electrons with the high pass filter that is set at the first voltage level, the high pass filter detecting a first electron intensity level of the scattered electrons;

setting the high pass filter at a second voltage level;

detecting the scattered electrons with the high pass filter that is set at the second voltage level, the high pass filter detecting a second electron intensity level of the scattered electrons;

determining a differential electron intensity level, which is the difference between the first electron intensity level and the second electron intensity level, the first voltage and the second voltage setting the limits to an electron energy range within which the first and second material emit different electron intensity levels;

repeating each of the setting, detecting and determining operations to obtain additional differential electron intensity levels for successively irradiated spots along the scanned specimen; and

evaluating each of the additional differential electron intensity levels that are determined for a change in intensity levels between subsequently determined differential electron intensity levels, whereby the change between subsequently determined differential electron intensity levels indicates an interface between the first and second materials.

8. A method as recited in claim 7 wherein the plurality of differential electron intensity levels are used to generate a scanning electron image of the specimen.

9. A method as recited in claim 7 wherein the first and second voltage levels are set to encompass an energy spectrum wherein the respective scattered electrons that are detected are secondary electrons.

10. A method for performing spectroscopy on a specimen by detecting electrons that scatter from the specimen comprising:

directing an electron beam to irradiate a spot on the specimen, the electron beam causing the electrons to scatter from the irradiated spot on the specimen;

setting a high pass filter at a first voltage level;

detecting the scattered electrons with the high pass filter that is set at the first voltage level, the high pass filter detecting a first electron intensity level of the scattered electrons;

setting the high pass filter at a second voltage level;

detecting the scattered electrons with the high pass filter that is set at the second voltage level, the high pass filter detecting a second electron intensity level of the scattered electrons;

determining a differential electron intensity level, which is the difference between the first electron intensity level and the second electron intensity level, whereby the differential electron intensity level is the electron intensity level in an energy window between the first and second voltage level; and

repeating each of the setting, detecting and determining operations to obtain additional differential electron intensity levels such that during each repeated cycle of setting, detecting and determining, the first voltage level is set to the second voltage level and the second voltage level is increased a determined increment, each of the successively determined differential electron intensity levels providing information as to an electron intensity spectrum for the specimen.

11. A method as recited in claim 10 wherein the first voltage level is initially set at zero and the final setting of the second voltage level is equal to the voltage level of the electron beam.

12. A method for inspecting a specimen by detecting electrons that scatter from the specimen comprising:

directing an electron beam to irradiate an inspected region on the specimen, the electron beam causing the electrons to scatter from the inspected region;

setting a high pass filter at a first voltage level;

detecting the scattered electrons with the high pass filter while set at the first voltage level, the high pass filter detecting a first electron intensity level of the scattered electrons that is used to generate a first image of the inspected region;

setting the high pass filter at a second voltage level;

detecting the scattered electrons with the high pass filter while set at the second voltage level, the high pass filter detecting a second electron intensity level of the scattered electrons that is used to generate a second image of the inspected region;

determining a first differential electron intensity level, which is the difference between the first electron intensity level and the second electron intensity level, wherein the first differential electron intensity level is the electron intensity level in an energy window between the first and second voltage level; and

generating a first resulting image of the inspected region from the differential electron intensity level.

13. A method as recited in claim 12 further comprising sequentially repeating the operations of claim 12 wherein refreshed differential electron intensity levels and respective refreshed resulting images of the inspected region are continuously generated.

14. A method as recited in claim 13 wherein the refreshed resulting images are generated substantially immediately after the previously generated refreshed resulting image so that the specimen can be viewed substantially in real-time.

15. A method as recited in claim 13 wherein the repeated operation of setting the high pass filter at the first voltage level is performed simultaneously with the operation of determining the first differential electron intensity level.

16. A method as recited in claim 13 further comprising:

scanning the electron beam such that the inspected region covers a new area on the specimen, the refreshed resulting images thereby representing images of the new area covered by the inspected region.

17. A method as recited in claim 12 wherein the first and second voltage levels are set to encompass an energy spectrum wherein the respective scattered electrons that are detected are secondary electrons.

18. A method as recited in claim 12 wherein the first and second voltage levels are set to encompass an energy spectrum such that scattered electrons displaying high mean free paths are not collected and scattered electrons displaying relatively lower mean free paths are detected, whereby the resolution of the inspection information is increased.

19. A method as recited in claim 12 wherein the specimen is a semiconductor wafer and the inspection information is used to measure a critical dimension on the semiconductor wafer.

20. An inspection system comprising:

a beam generator for generating an electron beam;

a detector having a high pass filter for detecting scattered electrons; and

a controller arranged to:

set the high pass filter at a first voltage level such that the detector detects the scattered electrons with the high pass filter while set at the first voltage level, the high pass filter detecting a first electron intensity level of the scattered electrons that is used to generate a first image of the inspected region; and

set the high pass filter at a second voltage level such that the detector detects the scattered electrons with the high pass filter while set at the second

voltage level, the high pass filter detecting a second electron intensity level of the scattered electrons that is used to generate a second image of the inspected region.

21. An inspection system as recited in claim 20 wherein the controller is further arranged to:

determine a first differential electron intensity level, which is the difference between the first electron intensity level and the second electron intensity level, wherein the first differential electron intensity level is the electron intensity level in an energy window between the first and second voltage level; and

generate a first resulting image of the inspected region from the differential electron intensity level.